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PEDESTRIAN ENVIRONMENT AND BEHAVIOR IN LAHORE, PAKISTAN

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ABSTRACT

According to statistics provided by Punjab Emergency and Rescue Services (PERS) in 2015 out of total road traffic accidents 25% involved pedestrians in Lahore. This paper has observed walking and crossing behavior of pedestrians in Lahore as well as the driver behavior towards pedestrians. A total of 1040 pedestrians are observed at eight different intersections along with a sample of 974 drivers. Data was treated and coded in SPSS 23.0 as categorical nominal. Pearson's Chi-square significance test (X^2) was performed at an alpha "α" level of 95% (*0.05*). Pedestrian behavior was investigated based on gender and age group while driver behavior was investigated based on their gender, age group and presence of traffic signal. Results showed significant difference in behaviors among age group of pedestrian in case of both side-walking ($p<0.05$) and road-crossing ($p<0.05$). Behavior of child and old pedestrian was significantly different while behaviors of young and adult pedestrian remained more or less similar. Pedestrians walked least safely at intersections located in commercial and residential neighborhoods. Drivers behavior towards pedestrian based on their gender ($p<0.05$), age group ($p<0.05$) and presence of traffic signal ($p<0.05$) remained significantly different. Driver's behavior with respect to pedestrians was found to be two times safer at signalized intersections as compared to un-signalized intersections.

Keywords: Child, Old, Pedestrian, *Driver*, *Behavior*, *Gender*, *Age Group*, *Lahore*

INTRODUCTION

Each year more than 270,000 people die on world roads and pedestrians constitute 22% of these deaths which is more than one fifth of total road crashes. In developing countries this proportion is as high as two thirds (WHO, 2013). Pakistan has one of the world's worst records when it comes to traffic safety. According to the WHO's report pedestrians account for 41% of total road accidents deaths in the country. However, the percentage is expected to be far high as pedestrian fatalities are less likely to be reported in comparison to other road user fatalities (Sodhar, Bhatti et. al., 2013). Only for Islamabad, the capital of Pakistan, police records informs that 56% of Road Traffic Accidents (RTAs) involve pedestrians including 79% males and 21% females (Zia *et al*., 2014). For Karachi, the largest and most populous city of the country, estimated 63% road traffic fatalities involve pedestrians (TRRL, 1996). For Lahore, which is the second largest city of Pakistan after Karachi, pedestrians deaths accounts for 30% of total road traffic fatalities in comparison to 10% cyclists and 8 % motorcyclists (JICA, 2012). In year 2015, it is estimated that 49,025 citizens of the city fell victims to 46,628 RTAs including 12,501 (25%) pedestrians' victims (Dogar, 2016). The situation is expected to get worse. The population of Lahore is growing at the rate of 3% per annum. It nearly doubled in last 20 years with current population of 10 million inhabitants, 80% of which is almost living within a radius of 7-8 km from the city center (World Demographic Report, 2015). Likewise, the travel demand of 6.8 million trips per week in 2005 is estimated to rise to more than 11 million by year 2021 (JICA, 2012). It is projected that the rate of urbanization in Pakistan is likely to hold for another few decades (Haider, 2014). This means that millions more are going to make their way to the country's large urban centers including Lahore. Therefore, it is important to note that only from 2001 to 2008 estimated number of registered vehicles in the city has increased by 294% (JICA, 2012). In Pakistan car sales are projected to grow at 12% per year from 2016 to 2020 (Hussain, 2016). This means vulnerable road users are more exposed to risk now than ever before. As not only there is poor provision for them in road infrastructure but there are more cars around to cause accidents.

On the other hand, it is worth noting that on average 1.14 million trips a day including walking are made in the city. These trips per 1000 residents are very low and almost half of the trips which are made in other Asian mega cities including Manila, Ho Ji Minh (JICA, 2012). It is estimated that in 1991, non-motorized traffic of the city was generating 60% of its all trips including 51% by pedestrian traffic (Imran and Low 2005). However, the percentage has fallen since then and a relatively recent study has estimated that 40% of all trips in Lahore are walking trips (JICA, 2012). For a city which is dominated by non-motorized trips with 84% of non-car owning households, the decline in walking trips and increase in pedestrian causality rates should be taken as a serious point of concern. Especially keeping in mind that pedestrian movement as a kind of human-oriented activity is not only associated with improving physical and mental health but sustainable urban development. Thus, the present study is initiated with an aim to investigate issues related to pedestrians' mobility in Lahore. Following section briefly reviews technical literature which has highlighted factors influencing pedestrians' safety on roads.

LITERATURE REVIEW

Human factors influence on pedestrians safety

Road safety literature agrees that pedestrians' safe mobility is associated with human behaviors (both pedestrians and drivers), general or situational factors, and factors connected

to infrastructure (Šucha, 2014). Traditional views of pedestrian traffic safety place the burden of responsibility on behavior of pedestrians and emphasize education as the means to prevent accidents (Sodhar *et al*., 2013). The literature informs that choice of crossing place, non-compliance at designated crossings, crossing speeds, pedestrian alcohol consumption, and failure to attend to traffic are the factors that can increase risk of road traffic collisions (TRL, 2006). With reference to choice of crossing place, signalized crossings are considered the safest as drivers are more likely to give way to pedestrians at formal crossings. However, statistics have also shown that pedestrians involving crashes can frequently occur at facilities designed for pedestrians. For instance, in Sweden 36% of all accidents involving injury between pedestrians and motor vehicles occur at pedestrian crossings[1]. This means that either these facilities are not necessarily good enough to prevent crashes or conversely pedestrian crossings are the locations at which roads are most often crossed[2] (ERSO, 2013 cited by Šucha, 2014).

Studies have also shown that pedestrian collisions not only occur due to negligent behavior by pedestrians (whether intentional or not) but poor interaction between pedestrians and drivers. For instance, pedestrian tend to cross the road when it suits them, in terms of convenience and saving time rather than thinking of potential safety implications (TRL, 2006). The literature about communication between pedestrians and drivers and its influence on pedestrians' safety informs that the likelihood of a driver giving precedence increases if information about the pedestrian's intention is increased by way of the combination of various forms of signs. A study concluded that while almost none of the drivers gave precedence at a zebra crossing when the pedestrian just stopped at the kerb and looked at the approaching drivers, 31% stopped or slowed down when the pedestrian looked at the driver, put his foot on the carriageway, and made a hand sign that he was about to cross (Persson, 1988). A few more Swedish studies also found similar results where only 30%, 4-6% and 24% of drivers gave priority to pedestrians at zebra crossings. Griffiths and Marlow (1984) reported same results for the UK where most drivers were only prepared to stop at a zebra crossing when a pedestrian still occupied or was approaching their part of the carriageway (TRL, 2006)..

Influence of demographics characteristics on pedestrians' safety

Road safety literature has also documented the influence of demographic characteristics on pedestrians' behaviors. It is widely demonstrated that pedestrians' collisions involve more males than females, and proportionally younger people than older people (TRL, 2006). Possible explanation is that women are less likely to ran and cross the street than men and they seem to perceive more risk (Holland, 2007) so as the case with older pedestrians. For instance, studies have shown that young people (aged between 17 and 25years) and especially young males are more likely to cross the road at unmarked crossings. Likewise children, particularly teenagers, perform a number of potentially unsafe pedestrian behaviors (Elliot *et al*., 2003). However, for complex traffic situation, studies have demonstrated that older pedestrian's road crossing behavior can be less safe than their younger counterparts (Oxley *et al*., 1995).

[1] Organization for Economic Co-Operation and Development OECD Annual Report 2009

[2] European Re-Integration Support Organizations ERSO Conference 20 November 2013, Brussels

Influence of land-use activities and roadway characteristics on pedestrians' safety

The type of land use e.g. shopping or residential are also found to influence pedestrian's behaviors. The likelihood of an accident rises in proportion to the socio-economic activity in the area (Šucha, 2014). For instance, higher pedestrian collision risk is associated with shopping land-use (Summersgill & Layfield, 1998). To add, roadway characteristics such as the absence of sidewalks, higher traffic volumes, higher vehicle speeds, and narrower unpaved shoulders increase the likelihood that a pedestrian/motor vehicle walking along roadway crash will occur. For instance, it is estimated that locations with no sidewalks are more than twice likely to have pedestrians/motor vehicle crashes than sites where sidewalks exist (FHWA, 2002).

To conclude, from the review of technical literature, it is evident that variety of factors significantly impact in pedestrian road traffic collisions including their sidewalk and crossing behavior, their demographics backgrounds, their interaction with drivers as well as characteristics of land uses and roadside features. However, little is known empirically about how these factors influence pedestrians' safety in Pakistan. Usually, high proportion of pedestrians' deaths in RTAs in the country is attributed to bad road etiquette including drivers not giving right of way to pedestrians, inadequate pedestrian walkways, lack of traffic control on many intra-city intersections, encroachment of sidewalks due to commercial activities and placement of garbage and garbage collection containers. It is argued that not only pedestrians' mobility recognition is overlooked in the country; but when provided pedestrians do not make appropriate use of pedestrian's facilities (Batool and Carsten, 2012; Sodhar *et al*., 2013; Zia *et al*., 2014; Randhawa, 2016). Thus this research work is initiated with an aim of understating pedestrian's mobility issues in Pakistan in context of human factors while taking Lahore as a case study. It has studied (1) pedestrian's side walking and road crossing behaviors, (2) pedestrian-driver interaction in the city and attempted (3) to understand the influence of socio-demographic characteristics, types of land-use activities and intersection control on these behaviors.

RESEARCH METHODOLOGY

Study locations

Data of pedestrian side-walking and road-crossing behavior and driver's interaction with pedestrian is collected at eight different intersections in Lahore (shown in Figure 1). These intersections are selected because of high numbers of pedestrian movements and existence of wide-ranging land-uses including commercial markets (categorized as highly developed, medium developed and less developed), educational institute, hospital and residential areas (categorized as high-income, middle-income and low-income areas). *Mall Road* (location 1) is one of Lahore's primary roads. Many famous restaurants, markets and shops are located here along with government offices. Land use is commercial with high development. *Urdu Bazaar* (location 2) is the largest books market with relatively less developed land use in comparison to other commercial locations. Heavy traffic flows and pedestrian movements are observed throughout the day at this location. *New Anarkali bazaar* (location 3) is famous for its housing of jewelry, garments and handicraft shops. Some famous food places are located here as well. Large numbers of women go to Anarkali for shopping daily. Land use is commercial with medium level development. *Punjab University* (location 4) is the largest and oldest university in Pakistan having more than 30,000 enrolled students. Large number of student trips are observed here in day time. *Shaukat Khanum* (location 5) is the largest cancer

hospital in the country having capacity of 600 beds. Purpose of selecting this site is to investigate pedestrian behavior at or near hospitals. *DHA Lahore* (location six) is high-income residential housing scheme with better roads infrastructure including traffic signals, zebra crossings, proper road markings and speed calming measures etc. The site is selected to observe behaviors where comparatively better facilities are available to pedestrians *Iqbal Town* (location seven) is middle-income residential area accompanied by the densely populated lower and middle income neighborhoods. *Gulshan-E-Ravi* (location eight) is low-income residential area which connects Lahore Ring Road and M-2 Motorway. Slums have grown in this area and large number of truck movements and commercial activities can be observed along its roads.

Setting

Total sample size taken for this study is 1040 pedestrians including 520 pedestrians observed for side-walking and 520 for road-crossing separately. Sample characteristics of pedestrians observed for both the behaviors can be seen in Table 1. 65 pedestrians are observed for side-walking and 65 for road-crossing as well at each intersection. So, a total of 130 pedestrian were observed at each intersection selected. The total sample was obtained using a commonly used equation $n = \left\lceil z_{\frac{\alpha}{2}}\sigma / E \right\rceil^2$.

A total of 974 drivers were observed for their interactive responses with respect to pedestrians 487 at signalized intersections and 487 at un-signalized intersections respectively.

Behavioral Measures

Pedestrian Side Walking Behaviors

Pedestrians are observed for their side-walking and road-crossing behaviors at all eight intersections separately. In side-walking four measures are observed including they looked for traffic when stepping on road from side-walk, they walked close to the side-walk if they were not walking on the side-walk, they walk against the traffic or had their backs towards the on-coming traffic, they seemed distracted (talking on cell phone, with other pedestrian in the group while walking).

Pedestrian Road Crossing Behaviors

In road-crossing twelve measures are observed including amount of time they waited at curb before crossing, number of attempts they made before crossing, they looked both left and right before crossing, they caused the traffic to swerve around them, they used zebra crossing, they ran to cross the street, they crossed one lane at a time, elderly pedestrian walked too slowly, child pedestrian showed unpredictable behavior, they increased walking speed when approached by a vehicle, they slowed down or stepped back when approached by a vehicle, they seemed distracted (talking on cell phone, with other pedestrian in the group while crossing).

Driver Behaviors

Behavior of drivers towards road crossing pedestrians is observed with respect to type of intersection control (*signalized and un-signalized).* Five behaviors which are observed include: they stopped the vehicle for pedestrian at the intersection, they slowed down the

vehicle when a pedestrian showed up, they accelerated the vehicle when a pedestrian showed up, they showed rude behavior or were aggressive towards pedestrian, they seemed distracted (using cell phone, talking with others while driving).

Data Collection

High Definition video recording were made at all the intersections[3]. The recorder was mounted on a tripod at a suitable point to provide clear and un-obstructive movements of the pedestrians at the intersection. Videos of 2 hour duration were recorded at all the locations because it was difficult to record videos more than 2 hours keeping in view the battery and storage limitations of the recording device. These videos were later transferred into PC and played back using VLC media player. At locations where pedestrian volume was higher frame by frame playback tool was also used.

Data Analysis

Coding

All the observed behaviors were treated as categorical nominal. Binary responses of "Yes" (*coded 1*) and "No" (*coded 0*) are selected against commission or non-commission of each behavior respectively.

Analysis

Statistical Package for Social Sciences (SPSS) software version 23.0 was used for data analysis. In all cases gender, age group, land-use activity and signal control is treated as independent variable whereas the different pedestrian and driver behaviors were treated as dependent variables. Pearson's Chi-Square test of significance was performed at a confidence level of 95% (i.e. alpha α of 0.05). Keeping in view the significance p values obtained from X^2 test null hypothesis was accepted or rejected based on $p>0.05$ or $p<0.05$ respectively.

RESULTS

Side Walking Behaviors

In side-walking only 43% of pedestrians looked for traffic before stepping on roads from the kerb of the footpaths. 39.6% walked closer to the footpath when they were not walking on the footpath, 29% walked along the direction of traffic and 23% are found to be distracted. It must be understood that pedestrians exhibited more than one type of behavior e.g. pedestrian looking for traffic before stepping on road might also be walking closer to the side-walk and hence included as "yes" in both these behaviors. So these behaviors are not mutually exclusive from each other.

Based on Gender

Side-walking results based on gender of pedestrians showed non-significant differences in behaviors as X^2 (3,520) = 7.82, p = 0.314. However, more number of females looked for

[3] With the help of SAMSUNG HMX F90 Camcorder

traffic when stepping on the street and walked closer to the side-walk as compared to males. Results presented in Table 3.

Based on Age Group

Side-walking result based on age group of pedestrians showed significant differences in behaviors as X^2 (3, 520) = 7.82, p = 0.002. Old pedestrians showed the safest side-walking behavior with 50% looking for traffic before stepping on street (in contrast to 12% child pedestrian), 65% walked closer to the side-walk (in contrast to 33% young pedestrian). Results presented in Table 3 and Figure 2.

Based on Land Use Characteristics

Table 4 presents side-walking results based on land use. Significant differences are observed in pedestrians side-walking behaviors with respect to different types of land-uses as X^2 (3, 520) = 7.82, p = 0.000. Pedestrians near hospitals and educational institutes walked safely and appeared to be less distracted in comparison to commercial and residential areas. Figure 4 further shows that level of development of commercial areas significantly influence pedestrians behavior (X^2 (3, 520) = 7.82, p = 0.000) so is the case with income-level of residential areas (X^2 (3, 520) = 7.82, p = 0.000) as shown in Figure 5. These differences may be attributed to the presence of encroachments in commercial areas and the non-availability of side-walks at the lower income area.

Results presented in Table 4.

Road Crossing Behaviors

It is found that on average, 24% pedestrians waited for more than 5 seconds and almost 22% pedestrians made more than 5 attempts before being able to cross the street, 29% found looking at both sides, 21% swerved the traffic and only 46% used zebra crossings. Whereas 16% pedestrians ran to cross the street, 22% crossed one lane at a time, more than 20% either increased their walking speed or slowed down or stepped back when a vehicle approached them, and 15% pedestrians seemed distracted while crossing the street.

Based on Gender

Pedestrian road-crossing behavior based on their gender showed non-significant difference as X^2 (11, 520) = 19.67, p = 0.109. Meaning that males and females more or less showed similar road-crossing behaviors. Only difference observed was that 20% males ran to cross the street as compared to only 10% females.

Results presented in Table 5.

Based on Age Group

Pedestrian road-crossing behavior was found to be significantly different among their age groups as X^2 (11, 520) = 19.67, p = 0.000. 82% older pedestrians observed walked too slowly and disturbed the traffic. 38% child pedestrians showed un-predictable behavior and confused the drivers. 76% older pedestrian had to wait more than 5 seconds before they were able to cross in contrast to only 8% child pedestrian and 79% older pedestrian had to make more than

5 attempts before crossing in contrast to 8% child pedestrian. Only 11% child looked both left and right before crossing as compared to 38% adults. 60% older pedestrian crossed one lane at a time. 29% child pedestrian increased their crossing speed when a vehicle approached them in contrast to only 2% older pedestrians.

Results of road-crossing based age group are presented in Table 5 and Figure 6.

Based on Land Use Characteristics

Overall pedestrian's road-crossing behavior did not vary significantly based on the land-use as given by X^2 (11, 520) = 19.67, p = 0.136. Only significant difference found was in use of zebra crossing as only 35% pedestrian used zebra crossings at residential locations as compared to 58% in hospital location. Similarly crossing behaviors remained non-significant based on level of development in commercial locations as X^2 (11, 520) = 19.67, p = 0.094. Only difference found in use of zebra crossings 36% used zebra crossing at lower developed location in contrast to 74% at higher developed. However based on level of income in residential locations significant differences in road-crossing behaviors were identified as X^2 (11, 520) = 19.67, p = 0.000. Behaviors were safer at higher and middle income areas and least safe at lower income area.

Results presented in Table 6 and Figure 7, 8 & 9.

Driver Behavior

Based on Traffic Control

On average half of the drivers stopped for pedestrians at intersection and more than 60% slowed down when pedestrians approached them. 33% of the drivers accelerated the speed of the vehicle while a less percentage of them seemed aggressive towards pedestrians or distracted while driving (using mobile phone/talking with fellow passengers etc.). Test result X^2 (4, 974) = 9.49, p = 0.000 shows significant difference with respect to intersection control on the interactive behaviors of drivers with pedestrians. It was identified that behavior of drivers with respect to pedestrians was safer and friendlier at signalized intersections in contrast to un-signalized intersections.

Result shown in Table 7 and Figure 10.

Based on Gender

Driver's interaction with pedestrian based on their gender showed significant difference as given by X^2 (4, 974) = 9.49, p = 0.000. Results presented in Table 8 inform that 45% male drives stopped for pedestrians as compared to 67% female drivers, 56% male drivers slowed down for pedestrians in contrast to 72% female drivers who slowed down when pedestrian showed up. Almost 3% male drivers were found exhibiting aggressive behavior towards pedestrians while none (0%) female driver showed any kind of aggression. Distraction among male drivers was also higher as compared to females (10% vs. 2%). So it can be concluded that female drivers show a safer and friendlier behavior towards pedestrians as compared to the male drivers.

Result shown in Table 7 and Figure 11.

Based on Age Group

Driver interaction with pedestrians at signalized intersections showed significant difference in behaviors among the age groups of drivers as evident from X^2 (4, 974) = 9.49, p = 0.000. Adult drivers were identified as safest based on their behaviors towards pedestrians while young and old drivers were least safe. Table 7 informs that 51% adult drivers stopped for pedestrian in contrast to 30% older drivers. 59% adult drivers slowed down when a pedestrian showed up in contrast to 30% older drivers. 26% younger drivers accelerated the speed when a pedestrian showed up in contrast to only 9% adult drivers. 2% young drivers were found to be aggressive towards pedestrians and distraction of 10% in younger drivers was also observed to be higher than drivers of other age groups.

Results presented in Table 7 & Figure 12 respectively.

COMPARISON OF RESULT WITH OTHER STUDIES

The effect of gender, age and land use activities on pedestrians side walking behaviors

It was identified that overall females have more safety margin and are less likely to take risks than males which was similar to the findings by (Raghuram, 2013; Ariane & Marie, 2011; Akash & Ankit, 2014; Yagil, 2000) when it comes to side-walking more females 124 (52%) looked for traffic before stepping on road from curb of side-walk as compared to 99 (35%) males and this behavior has been identified as the most hazardous as majority of pedestrian collision occurred as pedestrians stepped off the curb onto the path of on-coming near-side vehicle (Yagil, 2000). 39.6% pedestrians were not walking on the side-walk and this result was found to be quite higher than only 4.07% pedestrians who did not walk on side-walk in Hillsborough and 4.20% in Miami Dade in U.S.A (Kourtellis, 2013). 21.3% pedestrian observed for side-walking were distracted as compared to 15.84% pedestrian in Miami Dade (Kourtellis, 2013). Side-walking behaviors with respect to age group of pedestrians showed that older pedestrians were more safety oriented and less likely to take risks than other age groups as 27 (50%) looked for traffic and 35 (64.8%) walked closer to side-walk this checks in with another result stating that among various categories of pedestrians older people have higher safety margin and hence they are inclined to take very less risks than others (Akash & Ankit, 2014). Pedestrian side-walking behaviors showed significant differences with respect to land-use activities (level of development & level of income).

The effect of gender, age and land use activities on pedestrians road crossing behaviors

In road-crossing it was identified that 67 (28%) females and 59 (21%) males waited more than 5 seconds before being able to cross the street and 60 (25%) females and 53 (19%) males made more than 5 attempts before actually crossing the street this result was found to be in compliance with results of an earlier studies which showed that males have lesser waiting time and females have higher accepted time gaps (Raghuram, 2013). 115 (48%) females and 123 (44%) males used zebra crossings which was similar to the finding in another study which stated that compliance with other pedestrian rules is equivalent for male and female pedestrians: both men and women comply with use of zebra crossings, the starting position for crossing and crossing paths (Ariane & Marie, 2011). However, these numbers are quite less when compared to 72.21% and 79.58% pedestrians who used zebra crossings in Hillsborough and Miami Dade respectively (Kourtellis, 2013). 29 (12%) females

and 56 (20%) males ran to cross the street which checks in with result showing that men more often run during crossing and this could be due to a need to hurry or a desire to keep moving more in men than in females (Ariane & Marie, 2011). 65 (27%) females and 50 (18%) males crossed one lane at a time which suggests that males walk faster than females while crossing the roads (Raghuram, 2013). Road-crossing behaviors with respect to age groups showed that 38 (76%) older pedestrians waited for more than 5 seconds before crossing the street and 40 (79%) had to make more than 5 attempts before being able to cross the street and this rate was highest among other age groups of pedestrians. 30 (60%) old pedestrian crossed one lane at a time in case of two lane roads. 111 (21.3%) pedestrian slowed down or stepped back when vehicle approached them compared to only 11.4% pedestrians who stepped back when vehicle approached them in China (Zhuang & Wu, 2011). 25 (50%) among them were older pedestrian who stepped back when they saw a vehicle coming towards them;Also,41 (82%) older pedestrians walked too slowly while crossing and swerved traffic around them. All of these results were similar to findings of other studies which showed that older pedestrian have slower walking speeds and lesser visual capability and ability to perceive the speeds of on-coming vehicles as compared to young pedestrians and also due to the fact that older people experience difficulty in efficient processing of information about both the near-side and far-side traffic simultaneously (Oxley *et al*., 1997) and having higher accepted time gaps than other age groups (Akash & Ankit, 2014).The other age group which showed significantly different behavior was of child pedestrian. 24 (38%) un-accompanied children showed unpredictable behavior while encountering traffic which means they either stopped or moved forwards or backwards and confused the driver of approaching vehicle. 85 (16.3%) pedestrians ran to cross the street compared to 31.9% pedestrian who ran to cross the street in China (Zhuang & Wu, 2011). 25 (40%) among them were children who ran to cross the street which is more than any other age group showing this type of behavior while crossing. Only 5 (8%) children had to wait more than 5 seconds before crossing and needed more than 5 attempts for crossing the road which is similar to the finding of children having very less waiting times in contrast to other age groups (Akash & Ankit, 2014).

The effect of gender, age and intersection control types on pedestrians–drivers interaction

A study observed that only 1% of the city's drivers stopped at un-signalized intersections for pedestrians (Downing *et al*., 1991). Both of these behaviors (drivers speed choice and pedestrians wait/go strategy) are highly correlated and influence each other (described as drivers or pedestrians strategies to gain maximum – whether it means time, safe or comfort) (Šucha, 2014). At a collision speed of 50 km/h the risk of fatal injury for a pedestrian is almost eight times higher compared to a speed of 30 km/h (cited in Šucha, 2014). Cars are becoming safer by the day, by means of safety features but pedestrians on the other hand are becoming unsafe (TERI, 2012). From the drivers view point, TRL research into pedestrians at signals indicated that large number of vehicles at stop line may not be able to see pedestrians who are therefore at particular risk if they cross at the start of green traffic signal (TRL, 2006). 432 (88.7%) drivers stopped for pedestrians at signalized intersections in contrast to 119 (24.4%) at un-signalized intersections. 413 (84.8%) slowed down when pedestrian showed up due to their slower speeds at signalized intersections which reduced almost by half i.e. 210 (43.1%) at un-signalized ones. Only 70 (18.2%) driver accelerated speed when a pedestrian showed in front of them which increased by almost three times i.e. 260 (53.3%) driver who accelerated at un-signalized intersections. Aggressive behavior of driver towards pedestrian increased from 0 (0%) to 12 (2.4%) from signalized to un-signalized respectively.

This showed a significantly positive and safer behavior of drivers with respect to pedestrians at intersections where traffic control is available. Based on gender of drivers females showed a friendlier and safer behavior with respect to pedestrians as compared to males e.g. 174 (90%) vs. 258 (87.7%) at signalized and 49 (28.8%) vs. 70 (22%) at un-signalized intersections who stopped for pedestrians as compared to 44.12% and 44.75% drivers at Hillsborough and Miami Dade respectively who did not yielded to pedestrians (Kourtellis, 2013). 178 (92.2%) vs. 235 (79.9%) slowed down at signalized in contrast to 95 (55.8%) vs. 115 (36.2%) at un-signalized. 23 (11.9%) vs. 47 (15.9%) accelerated at signalized in contrast to 50 (29.4%) vs. 210 (66.2%) at un-signalized. None of the drivers showed aggressive behavior at signalized intersections while 0 (0%) female drivers vs. 12 (3.7%) male drivers were aggressive towards pedestrians at un-signalized intersections. These confirmed the results of a study stating that men engage in un-safe driving behaviors such as over-speeding more than women and they also underestimate the hazards involved in various driving activities more than women (Yagil, 2000). Based on age group of drivers it was identified that at signalized intersections old drivers 120 (99.1%) were the highest who stopped for pedestrians while at un-signalized adult drivers 69 (31.5%) were the highest who stopped. 199 (94.7%) adult drivers slowed down the speed at signalized and 49 (50.5%) older drivers slowed down at un-signalized. 34 (21.7%) young drivers were highest who accelerated the speed in case pedestrian showed up at signalized while 126 (57.5%) adult drivers did so at un-signalized intersections. At un-signalized 10 (5.9%) young driver were highest who were aggressive towards the pedestrians and young drivers were also the highest who were distracted i.e. 20 (12.8%) and 27 (15.9%) at signalized and un-signalized intersections respectively.

CONCLUSIONS AND RECOMMENDATIONS

Side Walking

Only 42.8% pedestrians looked for traffic before stepping on roads from sidewalks. This included only 12.5% child pedestrians who looked for traffic before stepping on road from sidewalks. Only 39.6% walked closer to the sidewalk due to the presence of encroachments and non-walkable conditions of the sidewalks. Only 32% young pedestrians walked closer to the sidewalks. On intersections located in residential areas only 21.5% pedestrians looked for traffic before stepping on road as compared to 73.6% who looked at the hospital intersection. At commercial locations 46.1% pedestrians were found walking having their backs towards on-coming traffic. Side walking behaviors were least safe at lower developed commercial and lower income residential neighborhoods.

Children should be given proper awareness at home and school level regarding safer side walking. Encroachments from the sidewalks should be completely removed. Non-walkable side-walks should be made walkable. Special attention should be given at sidewalks located at intersections in residential and commercial neighborhoods.

Road Crossing

24.2% pedestrians waited more than 5 seconds before crossing the street and 76% of them were older pedestrians. 21.7% pedestrians made more than 5 attempts before they were able to cross the street and 79% of them were older pedestrians. Only 29% pedestrians looked both left and right before they started crossing the street. Only 18.5% looked both left and right for traffic before crossing at intersection located in lower income neighborhood. 21.3% pedestrians swerved the traffic while they crossed the street. Only 45% pedestrians were found using zebra crossings. Only 35% used zebra crossings at intersections located at

residential locations. Only 36.9% used zebra crossings at intersection located at lower developed commercial neighborhood. 23% pedestrians crossed one lane at a time and 60% of them were older pedestrians. 38% child pedestrians showed unpredictable behavior while crossing which means that either they started running at once or stopped at once while seeing an approaching vehicle and confused the driver. 22.5% increased their crossing speed when they saw an approaching vehicle. 15.1% were distracted while crossing the street.

Keeping in view the longer waiting times required for crossing by older pedestrians and number of attempts they require before being able to properly and safely cross the street, traffic planners should pay special attention while designing cycle lengths for signals located at intersections. If pedestrian signals are to be installed at such locations their time margins should be enough to accommodate the older pedestrians having slower speed and weaker ability to accurately judge the speeds of on-coming vehicles. Only 45% pedestrians used zebra crossings which can be attributed to two reasons first pedestrians like to cross the street at whichever point they find suitable and comfortable. Second either zebra crossing are not visible or vehicles are stopping on the zebra-crossings. The situation was worse at those intersections where zebra crossings were not provided. Since child pedestrian are capable of showing unpredictable behavior which can confuse the driver they should be accompanied by some adult while crossing. Children should be given proper awareness in home and school level regarding safer crossing methods. At those intersections located near schools where child pedestrian volume is higher some adult should be deployed who can help the children safely cross the street by not allowing the traffic to pass until the children have finished crossing the street. Proper road-crossing infra-structure should be provided by the transport planners focusing especially at intersections located at lower developed commercial and lower income residential neighborhoods where crossing behavior was found to be quite unsafe.

Driver Behavior

87.7% stopped for pedestrians at intersections where traffic signal was present as compared to only 24.4% at intersections without traffic signal. Among them 51% drivers who stopped were adults. 84.8% slowed down when approaching a pedestrian at signal controlled intersection as compared to only 43.1% who slowed down at un-signalized intersections. Among them 59.5% drivers who slowed down were adult drivers. Only 18.2% drivers accelerated the speed of vehicle when they approached a pedestrian at signalized intersections in contrast to 53.5% who accelerated at un-signalized intersections. Among them 52.8% were male drivers including 26.9% young drivers who accelerated. 7.2% drivers were found to be distracted while driving.

Keeping in view the significantly safer behavior shown by drivers at signal controlled intersections the un-signalized intersections must be equipped with traffic signals wherever possible. Installation of pedestrian signals at intersection can further help the driver to adapt a better response while driving and make crossing of street a lot safer and easier for pedestrian as well.

LIMITATIONS OF RESEARCH

Only un-accompanied child pedestrians were observed in this research. Disabled pedestrians were not observed in this study. Only the interaction of drivers with pedestrian at signalized and un-signalized intersections was observed. Only car drivers were observed. Since the

video recordings and visual observations were made in real-time at the sites volume of child and older pedestrian was collected lesser as compared to young and adult pedestrians.

FIGURES

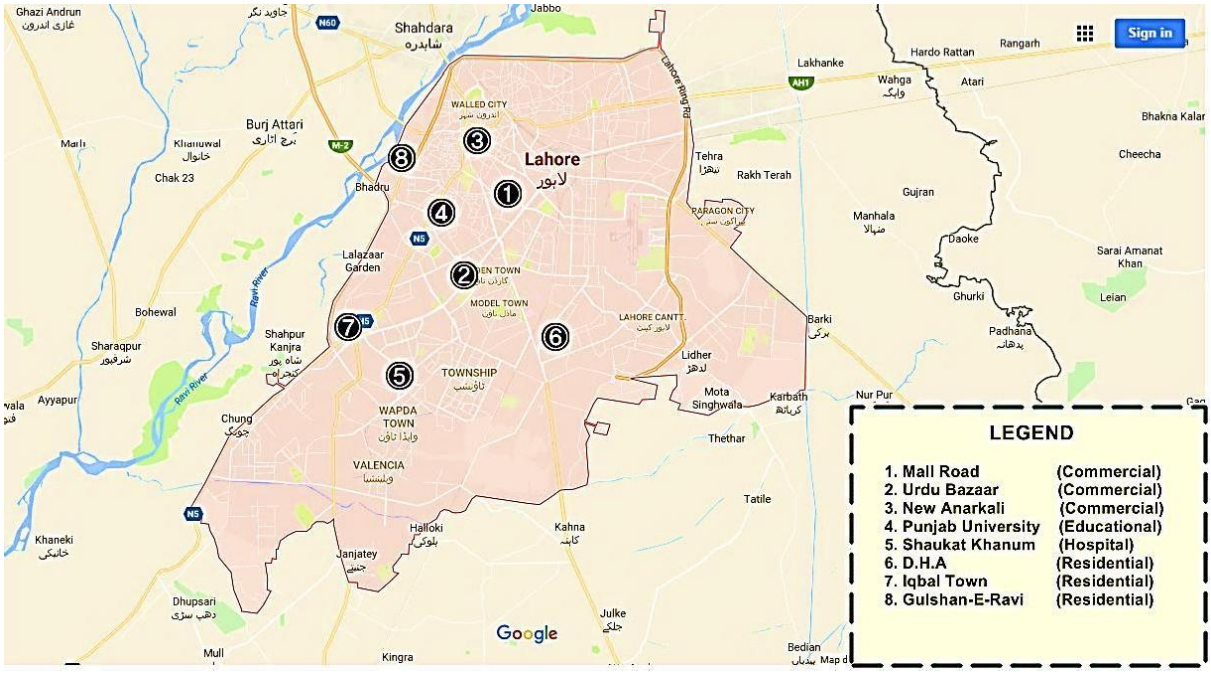
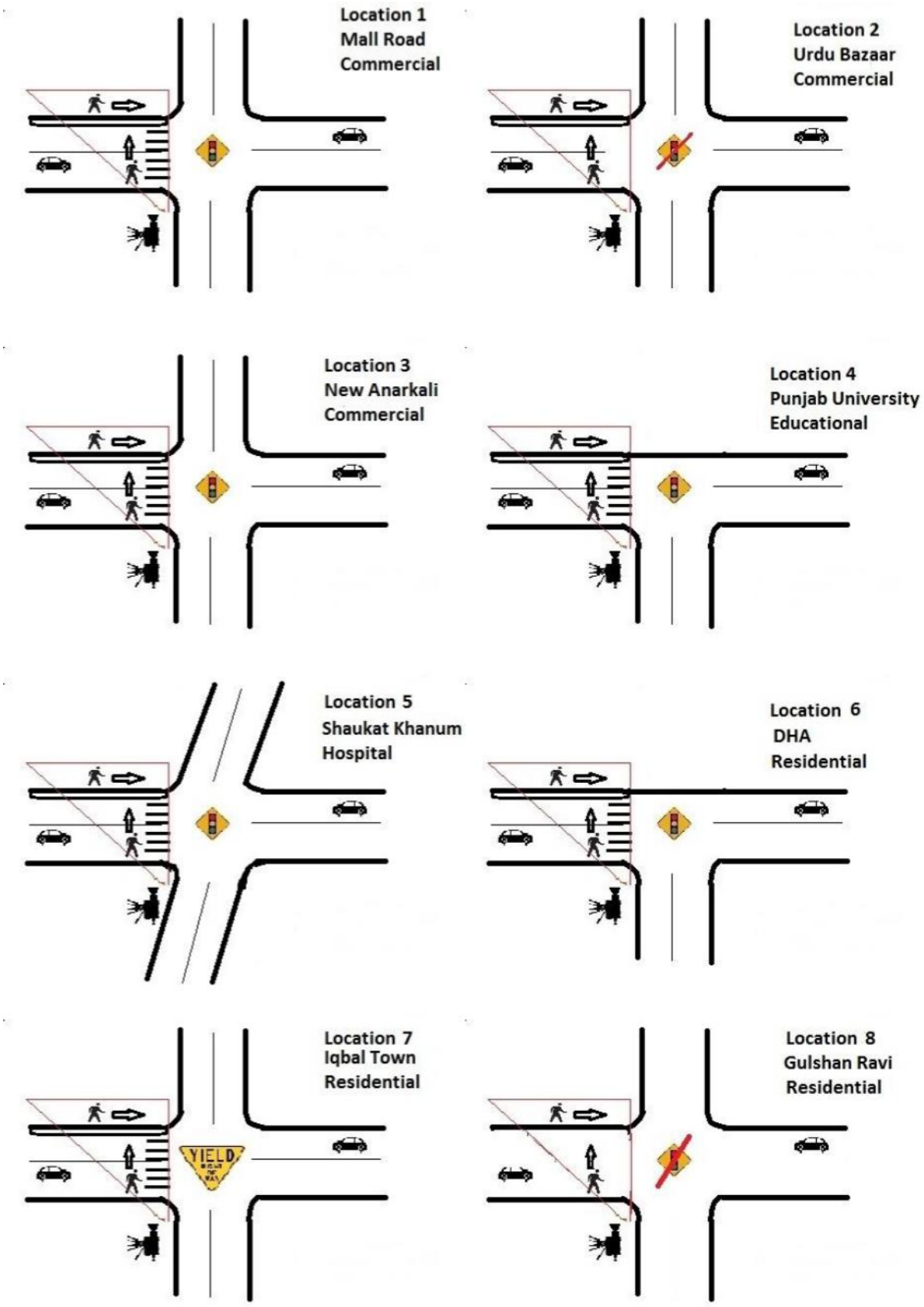


FIGURE 1: Study Locations on Map of Lahore (courtesy: Google Maps 2017)



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2 FIGURE 2: Plans of Intersections

TABLES

TABLE 1: Pedestrian Categorization

Total pedestrian observed (for side-walking)	520			
Total Male pedestrian observed for side-walking	282	54%		
Total Female pedestrian observed for side-walking	238	46%		
	Male	Female	Total	
Total child pedestrian observed for side-walking	28	24	52	10%
Total young pedestrian observed for side-walking	106	86	192	37%
Total adult pedestrian observed for side-walking	117	105	222	43%
Total old pedestrian observed for side-walking	31	23	54	10%
Total pedestrian observed (for road-crossing)	520			
Total Male pedestrian observed for road-crossing	280	54%		
Total Female pedestrian observed for road-crossing	240	46%		
	Male	Female	Total	
Total child pedestrian observed for road-crossing	34	29	63	12%
Total young pedestrian observed for road-crossing	107	109	216	41%
Total adult pedestrian observed for road-crossing	112	79	191	37%
Total old pedestrian observed for road-crossing	27	23	50	10%

TABLE 2: Driver Categorization

Total drivers observed (at signalized intersections)	487			
Total Male drivers observed	294		60%	
Total Female drivers observed	193		40%	
	Male	Female	Total	
Total young drivers observed	94	62	156	32%
Total adult drivers observed	126	83	210	43%
Total old drivers observed	74	48	121	25%
Total drivers observed (at un-signalized intersection)	487			
Total Male drivers observed	317		65%	
Total Female drivers observed	170		35%	
	Male	Female	Total	
Total young drivers observed	111	60	170	35%
Total adult drivers observed	143	76	219	45%
Total old drivers observed	63	34	97	20%

TABLE 3: Side Walking Based on Gender and Age Groups

Side Walking Behaviors	**Gender (%)**		**Total**	**Sig. p**
	Male	**Female**	**Out of 520**	
They looked for traffic before stepping on road from side-walk	35%	52%	42.8%	NS
They walked closer to the side-walk	35%	44.9%	39.6%	NS
They had their backs towards on-coming traffic	29%	28.9%	29%	NS
They seemed distracted	19%	23.9%	21.3%	NS
Side-Walking Behaviors	**Age Groups (%)**		**Total**	**Sig. p**
	Child, Young, Adult, Old		**(Out of 520)**	

They looked for traffic before stepping on road from side-walk	12.5%,44.7%,46.3%,50%	42.8%	0.051
They walked closer to the side-walk	44.2%,32.8%,38.28%,64.8%	39.6%	0.003
They had their backs towards on-coming traffic	12.5%,29%,33.7%,24%	29%	NS
They seemed distracted	11.5%,18.7%,26%,20.3%	21.3%	NS

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2 TABLE 4: Side Walking Based on Land Use Characteristics

Side-Walking Behaviors	**Land-Use of Locations (%)**				**Sig. p**
	Commercial	**Educational**	**Hospital**	**Residential**	
They looked for traffic before stepping on road from side-walk	29.2%	47.6%	73.8%	21.5%	0.040
They walked closer to the side-walk	30.7%	49.2%	73.8%	36.9%	NS
They had their backs towards on-coming traffic	46.1%	27.6%	13.8%	20.0%	0.000
They seemed distracted	23.0%	26.1%	13.8%	21.5%	NS
Side-Walking Behaviors	**Level of Development in Commercial Locations (%)**				**Sig. p**
	High Development	**Middle Development**	**Low Development**		
They looked for traffic before stepping on road from side-walk	55.3%	32.3%	0%[4]		0.000
They walked closer to the side-walk	35.3%	29.2%	25.0%		0.025
They had their backs towards on-coming traffic	70.7%	29.2%	36.9%		0.000
They seemed distracted	26.1%	18.4%	26.1%		0.050
Side-Walking Behaviors	**Level of Income of Residential Locations (%)**				**Sig. p**
	High Income	**Middle Income**	**Low Income**		
They looked for traffic before stepping on road from side-walk	33.8%	29.2%	0%[5]		0.001
They walked closer to the	47.6%	41.5%	20%		NS

[4] Side-walk encroached 100% at this location

[5] Side-walk not present at this location

side-walk				
They had their backs towards on-coming traffic	15.3%	15.3%	30.7%	0.010
They seemed distracted	15.3%	15.3%	32.3%	0.000

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2 TABLE 5: Road Crossing Based on Gender and Age Group

Road-Crossing Behaviors	**Gender (%)**		**Total**	**Sig. p**
	Male	**Female**	**Out of 520**	
They waited more than 5 seconds before crossing the road	21%	28%	24.2%	NS
They made more than 5 attempts before crossing	19%	25%	21.7%	NS
They looked both left and right before crossing	29%	29%	29%	NS
They swerved the traffic around them	19%	24%	21.3%	NS
They used zebra crossing	44%	48%	45.7%	NS
They ran to cross the road	20%	12%	16.3%	0.004
They crossed one lane at a time	18%	27%	22.1%	NS
Elderly pedestrian walked too slowly	6%	10%	7.8%	NS
Child pedestrian showed unpredictable behavior	5%	4%	4.6%	NS
They increased the walking speed when vehicle approached them	22%	23%	22.5%	NS
They stepped back or slowed down when vehicle approached them	20%	23%	21.3%	NS
They seemed distracted	12%	19%	15.4%	NS

Road-Crossing Behaviors	**Age Groups (%)**	**Total**	**Sig. p**
	Child, Young, Adult, Old	**Out of 520**	
They waited more than 5 seconds before crossing the road	8%,19%,22%,76%	24.2%	0.002
They made more than 5 attempts before crossing	8%,14%, 20%,79%	21.7%	0.000
They looked both left and right before crossing	11%,26%,38%,30%	29%	0.001
They swerved the traffic around them	10%,17%,29%,26%	21.3%	0.009
They used zebra crossing	56%,44%,40%, 64%	45.7%	0.018
They ran to cross the road	40%,19%,10%,0%	16.3%	0.000
They crossed one lane at a time	3%,14%,28%,60%	22.1%	0.000

Elderly pedestrian walked too slowly	0%,0%,0%,82%	7.8%	0.000
Child pedestrian showed unpredictable behavior	38%,0%,0%,0%	4.6%	0.000
They increased the walking speed when vehicle approached them	29%,27%,21%,2%	22.5%	0.000
They stepped back or slowed down when vehicle approached them	11%,15%,24%,50%	21.3%	NS
They seemed distracted	6%,17%,18%,10%	15.4%	0.006

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2 TABLE 6: Road Crossing Based on Land Use Characteristics

Road-Crossing Behaviors	**Land-Use of Locations (%)**				**Sig. p**
	Commercial	**Educational**	**Hospital**	**Residential**	
They waited more than 5 seconds before crossing the road	33.8%	18.4%	21.5%	16.9%	NS
They made more than 5 attempts before crossing	32.3%	18.4%	24.6%	10.7%	NS
They looked both left and right before crossing	69.2%	41.5%	33.8%	35.3%	NS
They swerved the traffic around them	52.3%	27.6%	10.7%	18.4%	NS
They used zebra crossing	52.3%	46.1%	58.4%	35.3%	0.009
They ran to cross the road	27.6%	21.5%	6.1%	9.2%	NS
They crossed one lane at a time	35.3%	21.5%	13.4%	13.4%	NS
Elderly pedestrian walked too slowly	9.2%	12.3%	7.6%	6.1%	NS
Child pedestrian showed unpredictable behavior	7.6%	3.0%	3.0%	4.6%	NS
They increased the walking speed when vehicle approached them	35.3%	23.0%	6.1%	15.3%	NS
They stepped back or slowed down when vehicle approached them	29.2%	15.3%	10.7%	20%	NS
They seemed distracted	15.3%	13.8%	9.2%	20%	NS

Road-Crossing Behaviors	**Level of Development (Significant only (%))**			**Sig. p**
	High Development	**Middle Development**	**Low Development**	
They used zebra crossing	73.8%	84.6%	36.9%	0.000

Road-Crossing Behaviors	**Level of Income (Significant only (%))**	**Sig. p**

	High Income	Middle Income	Low Income	
They waited more than 5 seconds before crossing the road	4.6%	9.2%	36.9%	. 0.000
They made more than 5 attempts before crossing	4.6%	9.2%	20.0%	0.036
They looked both left and right before crossing	44.6%	44.6%	18.5%	0.003
They used zebra crossing	58.5%	49.2%	0%	0.000

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2 TABLE 7: Driver Behavior Characteristics

Driver Behaviors	**Type of control (%)**		**Total**	**Sig. p**
	Signalized	**Un-signalized**	**Out of 974**	
They stopped for pedestrian at the intersection	87.7%	24.4%	56.5%	0.000
They slowed down when pedestrian approached them	84.8%	43.1%	63.9%	0.001
They accelerated the speed of the vehicle when a pedestrian approached them	18.2%	53.3%	33.8%	0.000
They were aggressive towards pedestrian	0%	2.4%	1.2%	0.000
They seemed distracted	6.9%	7.6%	7.2%	0.041
Driver Behaviors	**Gender (%)**		**Total**	**Sig. p**
	Male	**Female**	**Out of 974**	
They stopped for pedestrian at the intersection	45.8%	67.4%	56.5%	NS
They slowed down when pedestrian approached them	56.1%	71.9%	63.9%	0.000
They accelerated the speed of the vehicle when a pedestrian approached them	52.8%	15.0%	33.8%	0.000
They were aggressive towards pedestrian	2.5%	0%	1.2%	0.008
They seemed distracted	10.1%	2.5%	7.2%	0.005
Driver Behaviors	**Age Groups (%)**		**Total**	**Sig. p**
	Young , Adult, Old		**Out of 974**	
They stopped for pedestrian at the intersection	31.2%,51.1%,30.8%		56.6%	0.001
They slowed down when pedestrian approached them	38.0%,59.5%,30.4%		63.9%	0.006
They accelerated the speed of the vehicle when a pedestrian approached them	26.9%,9.7%,10.7%		33.8%	0.000
They were aggressive towards pedestrian	2.1%,0.4%,0%		1.2%	0.002
They seemed distracted	9.7%,4.5%,0.4%		7.2%	0.000

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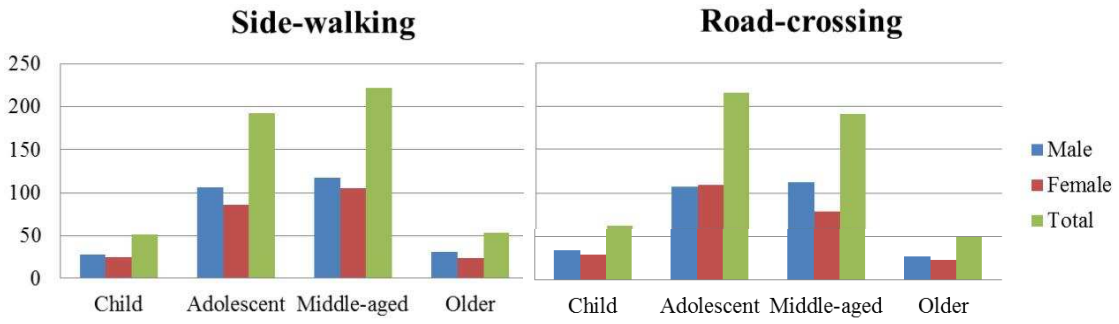

Figure 1: Sample distribution of pedestrians

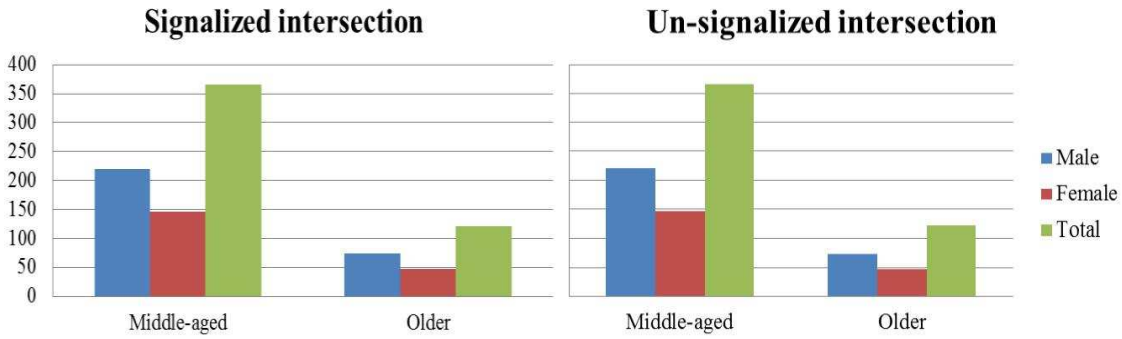

Figure 2: Sample distribution of drivers

Figure 3: Position of video camera at an Intersection

Table 1.a: Characteristics of locations

Sr.	Name of Intersection	Land use of neighborhood	Traffic light signal	Pedestrian signal	Zebra crossing	Side walk	Date	Time
1	Mall Road	Commercial with high development	Yes	N.A	Yes	Yes (20% encroached)	12/04/16	1-2 PM
2	Urdu Bazar	Commercial with low development	N.A	N.A	N.A	Yes (100% encroached)	25/04/16	1-2 PM
3	New Anarkali	Commercial with medium development	Yes	N.A	Yes	Yes (40% encroached)	26/04/16	1-2 PM
4	Punjab University	Educational	Yes	N.A	Yes	Yes (10% encroached)	05/05/16	1-2 PM
5	Shaukat Khanum Memorial Cancer Hospital	Hospital	Yes	N.A	Yes	Yes (no encroachment)	12/05/16	1-2 PM
6	Defence Housing Authority Phase 6	Residential with high income	Yes	N.A	Yes	Yes (no encroachment)	11/06/16	1-2 PM
7	Iqbal Town	Residential with middle income	N.A	N.A	Yes	Yes (30% encroached)	12/06/16	1-2 PM
8	Gulshan Ravi	Residential with low income	N.A	N.A	N.A	N.A	12/06/16	1-2 PM

Table 1.b: Sampling

Sr.	Name of Intersection	Side walking pedestrians	Road crossing pedestrians	Drivers at Signalized sites	Drivers at Un signalized sites
1	Mall Road	65	65	97	-
2	Urdu Bazar	65	65	-	160
3	New Anarkali	65	65	97	-
4	Punjab University	65	65	99	-
5	Shaukat Khanum Memorial Cancer Hospital	65	65	97	-
6	Defence Housing Authority Phase 6	65	65	97	-
7	Iqbal Town	65	65	-	162
8	Gulshan Ravi	65	65	-	165
	Total	520	520	487	487
		1040 pedestrians		974 drivers	

Table 2: Pedestrians sampling

Side walking	Male	Female	Total
Total	282	238	520
Child	28	24	52
Adolescent	106	86	192
Middle Aged	117	105	222
Older	31	23	54
Road Crossing	**Male**	**Female**	**Total**
Total	280	240	520
Child	34	29	63
Adolescent	107	109	216
Middle Aged	112	79	191
Older	27	23	50

Table 3: Drivers sampling

Signalized intersections	Male	Female	Total
Total	294	193	487
Middle Aged	220	146	366
Older	74	47	121
Un signalized intersections	**Male**	**Female**	**Total**
Total	317	170	487
Middle Aged	254	136	390
Older	63	34	97

Table 4: Age limits (WHO, 2013)

Age Group	Limit in years
Child	Less than 10
Adolescent	Between 10-19 (inclusive)
Middle aged	20-60
Older	More than 60

Table 5: Side walking results

Gender	Male (%)	Female (%)	Total (%)	Sig. p
Looked for traffic	35	52	42.8	NS
Walked closer	35	44.9	39.6	NS
Backs facing the traffic	29	27.5	29	NS
Distracted	19	23.9	21.3	NS

Age Group	Child (%)	Adolescent (%)	Middle Aged (%)	Older (%)	Total (%)	Sig. p
Looked for traffic	12.5	44.7	46.3	50	42.8	0.050
Walked closer	44.2	32.8	38.28	64.8	39.6	0.003
Backs facing the traffic	12.5	29	33.7	24	29	NS
Distracted	11.5	18.7	26	20.3	21.3	NS
Land use	**Commercial (%)**	**Educational (%)**	**Hospital (%)**	**Residential (%)**		**Sig. p**
Looked for traffic	29.2	47.6	73.8	21.5		0.040
Walked closer	30.7	49.2	74	36		NS
Backs facing the traffic	46.1	27.6	13.8	20		0.000
Distracted	23	26.1	13.8	21.5		NS
Level of Development	**Higher (%)**	**Middle (%)**	**Lower (%)**			**Sig. p**
Looked for traffic	55.3	32.3	0			0.000
Walked closer	35.3	29.2	25			0.025
Backs facing the traffic	36.9	29.2	70.7			0.000
Distracted	26.4	18.4	26.1			NS
Level of Income	**Higher (%)**	**Middle (%)**	**Lower (%)**			**Sig. p**
Looked for traffic	33.8	29.2	0			0.000
Walked closer	47.6	41.5	0			0.000
Backs facing the traffic	15.3	15.3	30.7			0.010
Distracted	15.3	15.0	32.3			0.000
Traffic Signal	**Signalized (%)**	**Un signalized (%)**				**Sig. p**
Looked for traffic	45	56				NS
Walked closer	46	43				NS
Backs facing the traffic	27	31				NS
Distracted	21	37				NS

Table 6: Road crossing results (Significant results only)

Gender	Male (%)		Female (%)		Total (%)	Sig. p
Ran to cross	20		12		16.3	0.004
Age Group	**Child (%)**	**Adolescent (%)**	**Middle aged (%)**	**Older (%)**	**Total (%)**	**Sig. p**
Waited > 5 seconds	8	19	22	76	24.2	0.002
Made > 5 attempts	8	14	20	79	21.7	0.000
Looked both ways	11	26	38	30	29	0.001

Swerved traffic	10	17	29	26	21.3	0.009
Zebra crossing	56	44	40	64	45.7	0.018
Ran to cross	40	19	10	0	16.3	0.000
One lane at time	3	14	28	60	22.1	0.000
Increased walking speed	29	27	21	2	22.5	0.000
Distracted	6	17	18	10	15.4	0.006
Land use	**Commercial (%)**	**Educational (%)**	**Hospital (%)**	**Residential (%)**		**Sig. p**
Zebra crossing	52.3	46.1	58.4	35.3		0.009
Level of Development	**Higher (%)**	**Middle (%)**	**Lower (%)**			**Sig. p**
Zebra crossing	73.8	84.6	0			0.000
Level of Income	**Higher (%)**	**Middle (%)**	**Lower (%)**			**Sig. p**
Waited > 5 seconds	4.6	9.2	36.9			0.000
Made > 5 attempts	4.4	9	20			0.036
Looked both ways	44.6	44	18.5			0.003
Zebra crossing	58.5	49.2	0			0.000
Traffic Signal	**Signalized (%)**	**Un signalized (%)**				**Sig. p**
Waited > 5 seconds	44	80				0.004
Made > 5 attempts	40	74				0.005
Looked both ways	22	39				0.006
Swerved traffic	34	63				0.006
Zebra crossing	53	29				0.006

Table 7: Driver results

Gender	**Male (%)**	**Female (%)**	**Total (%)**	**Sig. p**
Stopped	45.8	67.4	56.6	NS
Slowed down	56.1	71.9	64	0.000
Accelerated	52.8	15	33.9	0.000
Aggressive	2.5	0	1.2	0.008
Distracted	10.1	2.5	6.3	0.005
Age Group	**Middle Aged (%)**	**Older (%)**	**Total (%)**	**Sig. p**
Stopped	82.3	30.8	56.6	0.001
Slowed down	70.9	30.4	64	0.007
Accelerated	36.6	10.7	33.9	0.001
Aggressive	2.5	0	1.2	0.002
Distracted	14.2	1.4	6.3	0.040
Traffic Signal	**Signalized (%)**	**Un signalized (%)**		**Sig. p**
Stopped	87.7	24.4		0.000
Slowed down	84.8	43.1		0.001
Accelerated	18.2	53.3		0.000
Aggressive	0	2.4		0.000
Distracted	6.9	7.6		0.041

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

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